REMARKS

This amendment is in response to the Office Action mailed January 23, 2006. Claims 1-3 and 5-6 are amended. Claims 4 and 18 are canceled. Claims 7-17 are withdrawn.

Applicants wish to thank the Examiner for the indication of allowable subject matter in claims 3-6. Applicants respectfully submit, however, that each of claims 1-3 and 5-6, as amended also patentably distinguish over the art of record.

Independent claims 1 and 2 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,028, 730 to Ishihara (Ishihara). Applicants respectfully traverse these rejections.

Among the limitations of independent claim 1 which is neither taught nor suggested in the prior art of record is "a two-axis magnetic sensor comprising: . . . at least one magnetoresistive element formed on the substrate per axis . . . wherein a magnetization direction of a pinned layer of each magnetoresistive element forms a prescribed angle of 45° relative to a longitudinal direction of the magnetoresistive element." Among the limitations of independent claim 2 which neither taught nor suggested in the prior art of record is "a two-axis magnetic sensor comprising... at least one magnetoresistive element formed on the substrate per axis. . . wherein a magnetization direction of a pinned layer of each magnetoresistive element forms a prescribed angle of 45° relative to a direction of magnetizing the respectively connected at least one pair of permanent magnet films." The present invention is directed to a bearing sensor that is designed to identify a direction of an external magnetic field within the complete angular range of 360° degrees. When the pinned layer direction is established at 90° with respect to the longitudinal direction of the magnetic sensor, it is possible to obtain a high sensitivity, however, as described in the background of the specification, such sensor may be degraded as a result of high-magnetic-field characteristics (e.g., off set variations after exposure of 100 oersted). The present invention realizes a two-axis magnetic sensor in which the pinning direction is set to 45° so as to improve the stability against the high-magnetic-field exposure. Such a sensor is not simply designed to improve its sensitivity. By setting the pinning direction to 45° with respect to the longitudinal direction of the magnetic sensor or its permanent magnet films respectively, it is possible to improve the stability of the sensor against a high-magnetic-field exposure that would cause an offset. The claimed two-axis magnetic sensor, including the advantages attained thereby, are neither taught nor suggested in the prior art of record.

Ishihara's invention is directed to improve the sensitivity of a magnetic reading head. Ishihara teaches a method of re-pinning the pinned layer of a sensor in a direction A using a current pulse E in response to an offset of the magnetic direction of the pinned layer by a high-magnetic-field. As shown in Fig. 3, the current pulse E is supplied through the sensor's layers in a direction opposite of the detection current C. The current pulse E re-establishes the magnetization direction A of the pinned layer perpendicular to the current pulse E. Thus, the pinned magnetization direction A is in the same direction as the external magnetic field B, and is 90° degrees with respect to longitudinal direction of the magnetic sensor. Ishihara, however, fails to teach or suggest a pinned layer having a magnetization direction 45° from the longitudinal direction of the magnetic sensor.

The Office Action improperly uses hindsight to state that it would have been obvious to aligned the pinned layer in a direction offset 45° from the longitudinal direction of the magnetic sensing element. The Office Action does not provide any teaching or suggestion how to modify Ishihara so that the pinned layer could be aligned in such a direction. It is, in fact, not possible to re-align the magnetic direction of the pinned layer 45° from the longitudinal direction of the sensing element by passing a current pulse through the element. Such a current can only align the magnetization direction of the pinned layer in a direction perpendicular to the longitudinal direction of the element as taught by Ishihara. Accordingly, one of skill in art would not be motivated by the teachings and suggestions of Ishihara to alter the prescribed angle to 45°. Accordingly, applicants respectfully submit that independent claims 1 and 2 patentably distinguish over the art of record.

Claims 3, 5 and 6 depend either directly or indirectly from independent claims 1 and 2 and include all the limitations found therein. Each of these dependent claims include additional limitations which, in combination with limitations of the claims from which the depend are neither disclosed nor suggested in the prior art of record. Accordingly, claims 3, 5 and 6 are likewise patentable.

In view of the foregoing, favorable consideration of the amendments to the claims and allowance of the present application is respectfully and earnestly solicited.

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Respectfully submitted,

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